# MEASURING GLOBAL STOCK MARKET EFFICIENCY

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# MEASURING GLOBAL STOCK MARKET EFFICIENCY

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# Abstract

This paper studies global stock market efficiency on the basis of Bernard and Thomas's (1990) "delayed response" hypothesis, and Lee and Rui's (2011) works on investor perceptions of earnings processes and post-announcement drift. With an application of the proxy for investor perception on the temporary and permanent earnings driven from Nelson's decomposition techniques, the stock market efficiencies of 11 countries were estimated.

By assuming that investors will put weights on each permanent and temporary earnings process as they expect future abnormal returns, this study uses the weight on the temporary earnings process as an estimation proxy for stock market efficiency.

From La porta et al (2000), it is possible to think that market efficiency is closely related to investor protection and effectiveness of law enforcement. On the conjecture that good investor protection, effectiveness of law enforcement, and well established accounting standards lead markets to become more efficient, the market efficiency of 11 countries are estimated with a newly developed measure, and then compare the result to indices of La porta et al (2000) that show the degree of investor protection, the effectiveness of law enforcement, and accounting standards.

The average market efficiency of Scandinavian civil law countries (Finland, Sweden) is 0.82, the highest score among the four legal origins examined, as the countries are well equipped with efficient legal systems to protect investors, and with the best accounting standards in La porta et al (2000). French (Italy, Spain) and German (Austria, Germany, Greece) civil law countries show little difference in average market efficiencies as they have a similar level of investor protection and legal enforcement efficiency in study of La porta et al (2000). All in all, estimation result of market efficiency is consistent to study of La porta et al (2000).

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## 1 Introduction

In previous years, 'post-earnings-announcement drift' has been a debatable issue in academia. Although efficient market theorists insists that the market is efficient and it reflects new information immediately after announcements, Bernard and Thomas (1989) shows that there exists a strategy that can produce an abnormal return of 18% during the first quarter after an earnings announcement.

Among the several explanations of the anomaly, it looks plausible that the phenomenon is caused by investors' misperceptions of the earnings response, and on the basis of the previous studies of Bernard and Thomas (1990), and Lee and Rui (2011), the earnings process has seasonality. Because of the seasonality, stock returns show an autocorrelation.

In the conventional framework, market expectation is formed by mathematical framework under full information. In other words, in an abnormal return, the difference between actual earnings and expectation is random. However, in the Bernard and Thomas view point, the earnings process follows a seasonal random walk, and abnormal returns are correlated.

In 2011, Lee and Rui suggested a framework which is a generalization of the both conventional and the Bernard and Thomas's frameworks. They decompose the earnings process into permanent and temporary components by Beveridge and Nelson's (1981) decomposition method. The permanent component of earnings follows the seasonal random walk process representing Bernard and Thomas view point, and the temporary component represents the conventional framework of an efficient market hypothesis. By assuming that the market assigns different weights to the two components of earnings (conventional, and Bernard and Thomas's), the abnormal return can be explained by the weighted average of permanent and temporary components.

Their approach allows for measuring stock market efficiency with a coefficient of temporary components. If a market is efficient, abnormal returns are random and investor expectation on abnormal returns depends only on a temporary component of earnings. The larger coefficient of the temporary component means that abnormal returns depend more on unexpected earnings, and the market is more efficient.

Lee and Rui (2011) estimated market efficiency with a two-stage procedure. In the first stage, estimations of the earnings process and abnormal returns were implemented. Then, with the residuals of earnings and abnormal returns, relative weights were put on the temporary component and used to measure market efficiency.

After the estimation of market efficiency, a relation between market efficiency and legal origin is found. It is a general prediction that investor protection is positively related to development of financial market. La Porta, Lopez-de-Silanes, Shleifer, and Vishny‘s (2000) suggest indices that compare investor protection and the effectiveness of law enforcement among four legal origins: common law, French civil law, German civil law, and Scandinavian civil law. The second purpose in this paper is to find if there is a relation between the indices and market efficiency estimated in this paper.

For the estimation of market efficiency, 10,985 companies from 11 countries were used to construct 11 indices, and to estimate market earnings. The result of the stock market efficiency estimation was consistent to study of La porta et al (2000) on investor protection and financial market.

## 2. Market Efficiency and Legal Origin

### 2.1 Efficient market hypothesis

In an efficient market, all available information is fully reflected in security prices (Fama, 1991). Market price is an unbiased estimate of the true value of an asset, but this does not mean that market

price is always the true value. There are equal probabilities that a market price is undervalued or overvalued.

The point of an efficient market hypothesis is that the deviations from a true value are random. There is no correlation with any observable variables, and no investor may earn abnormal returns consistently. Thus, if a market is efficient, abnormal returns should be white-noise, and not be serially correlated.

### 2.2 Post-announcement drift

Since no one beats an efficient market, there cannot be a strategy that brings consistent abnormal returns. Also, it means that any pattern of undervaluation or overvaluation in stock price does not exist. Therefore, if someone finds patterns of returns, it will be a challenge against the efficient market hypothesis.

Ball and Brown (1968) found that announced information is not fully reflected into market price, and cumulative estimated abnormal returns continued to drift up or down. Even though Fama (1991) suggested that the anomaly is a product of research design flaws, Bernard and Thomas (1989) show an implementable strategy that produces consistent abnormal returns.

Among several explanation on the cause of the anomaly, Bernard and Thomas (1989) describe that the cause of anomalies is investors' misperception. In their explanation, stock returns are auto-correlated and proportional to unexpected earnings, if investors expect future earnings based on the assumption that earnings follow a random walk with seasonality. Then, the seasonality leads to post-announcement drift in returns.

### 2.3 Generalization of the two view points

Lee and Rui (2011) generalize the two view points on investor perception. They decompose the earnings process into permanent and temporary components by using Beveridge and Nelson's

decomposition method. The permanent component is related to Bernard and Thomas's view point, and the temporary component is about efficient market hypothesis. Thus, the autocorrelation of the permanent component is not zero, while the serial correlation of the temporary component is zero. Then, by allowing for the possibility that investor expectation on abnormal returns is a weighted average of the two components, they estimate the earnings response coefficient, and the weights on the temporary and permanent components. It means that Lee and Rui allow for investors' partial recognition of temporary components.

The coefficient for a temporary component can be used as a proxy for market efficiency. The temporary component follows a non-random walk process. Thus, if an abnormal return depends only on a temporary component, it is white noise. The closer the coefficient is to one means the market is more efficient.

### 2.4 Legal origin, investor protection, and market efficiency

According to La porta et al (1997), development of a financial market is related to investor protection and the effectiveness of law enforcement. The valuation of firms, market breadth, and the rate of initial public offerings are encouraged by shareholder rights protections, and effective law enforcement. The better protection and the more effective law enforcement make a market more attractive, especially to minor shareholders. In a favorable environment to minor shareholders, they do not have to take higher risks caused by possibility of expropriation, which then it leads to more market participants. Since markets become efficient when active investors put into effect schemes to beat the market, it is possible to conjecture that more investors leads to a more efficient market.

The degree of shareholder rights protections and the effectiveness of law enforcement are different among the four kinds of legal origins examined in this study: common law, German civil law, French civil law, and Scandinavian civil law. The research results of La porta et al (2000) show that investor protection in common law countries is better than others, and Scandinavian countries have the most

effective law enforcement systems. Thus, a conjecture that the market efficiency of common law and Scandinavian countries is higher than German and French civil laws countries are higher is also possible.

### 2.5 Hypothesis development

The methodology of Lee and Rui (2011) allows for measuring market efficiency with the coefficient of temporary components, and from the result of La porta et al (1997), it is possible to conjecture that there is a positive relation between market efficiency and investor protection. In this paper, efficiency of stock markets is measured, and then relation between market efficiency and investor protection is tested.

## 3. Methodology[i]

### 3.1 Permanent and temporary components of earnings processes

Separation of the earnings processes into "permanent" and "temporary" allows us to explain abnormal returns as a weighted average of random-walk and non-random walk earnings processes. The coefficient of the non-random walk process plays a role of proxy for market efficiency defined as $w$ ranging from 0 to 1. The seasonally differenced earnings process is assumed to follow the autoregressive, moving average process of orders p and q.

$$\mathrm{a(L)}(1 - L^4)Y_t = f + b(L)e_t$$

where a($L$) and b($L$) are polynomials, $Y_t$ is quarterly earnings at time t, $e_t$ denotes a random shock, and $L$ represents the lag operator. Using the rearrangement and decomposition method (Beverage and Nelson, 1981), an earnings process can be expressed by

[i] This paper is based on Lee and Rui's work in 2011. Thus, the basic methodology is consistent to their work (2011).

$$Y_t = Y_t^P + Y_t^T$$

$$= \mathrm{g} + Y_{t-4}^P + \mathrm{C}(1)e_t + C^*(L)e_t$$

where $Y_t^P$ is a permanent component of quarterly earnings that follows a random walk process, $Y_t^T$ represents the temporary component (non-random walk) at time t and $C^*(L) = (1 - L^4)^{-1}[C(L) - C(1)]$.

In the previous work of Lee and Rui (2011), $Y_t$ indicates firm-level earnings. However, since this paper aims to estimate market efficiency, $Y_t$ indicates market earnings.

3.2 Abnormal returns

Bernard and Thomas (1990) assume that the relation between abnormal returns and unexpected earnings is

$$AR_t = \lambda[Y_t - E_{t-1}^M(Y_t)]$$

where $AR_t$ is abnormal returns, $\lambda$ is the earnings response coefficient, and $Y_t$ is earnings.

Using decomposition of earnings, we have,

$$AR_t = w\lambda[Y_t - E_{t-1}(Y_t)] + (1 - w)\lambda[Y_t - E_{t-1}(Y^P)]$$

When a market is efficient, w is 1 because it means all information on permanent earnings is already reflected in the market, and the expectation on abnormal returns depends only on the temporary component of earnings.

**4. Estimation**

4.1 Data and sampling

In total, eleven countries were selected to compare the market efficiency of the four legal origins; three common law countries (USA, Hong Kong, Singapore), two French civil law countries (Italy, Spain), three German civil law countries (Austria, German, Greece), and two Scandinavian civil law countries (Finland, Sweden). To estimate the market efficiency of each country, only local markets were considered. In other words, common markets such as Euronext are not considered in this paper.

Because of the limitation of data, indices that can represent each country were made. Each index consists of companies that satisfy the following conditions: (1) both the earnings and stock data are available[ii], (2) the data is in the local currency of each country, (3) quarterly earnings data is available, and (4) there are no consecutively missing earnings data[iii].

[ii] To keep consistency and consider dead stocks, when either one of earnings or stock data was not available, neither were considered. For example, if earnings data is available during 2005Q1 and 2013Q1 while stock data exists only between 2007Q1 and 2013Q4, then the company is assumed to exist between 2007Q1 and 2013Q1.

iii For companies containing non-consecutive missing earnings data but containing missing data, imputation was implemented. Specifically, $Y_t^m = \frac{Y_{t+1}+Y_{t-1}}{2}$, where $Y_t^m$ is missing earnings data at time t.

Table 1

Number of Index Constituents

Each index that represents each country is made on the basis of Datastream and Compustat data. The selected companies satisfy the conditions: (1) quarterly reporting period, (2) reports in local currency, (3) traded in local exchange, (4) data available in both Datastream and Compustat. The number of constituents varies because of economic fluctuation and data availability in both datasets. The base date of each index is Jan 1, 2003.

The following table shows the total number of constituents during the whole period (2003Q1~2013Q4), and the average number of companies used to calculate an index in each quarter.

| | Austria | China | Finland | Germany | Greece | Hong Kong | Italy | Singapore | Spain | Sweden | USA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 63 | 2237 | 125 | 639 | 167 | 616 | 261 | 445 | 119 | 421 | 5892 |
| Average | 42 | 1481 | 97 | 419 | 44 | 423 | 175 | 291 | 81 | 285 | 3873 |

Stock and earnings data between 2003Q1 and 2013Q4 are from Compustat Global (Compustat Global item #21, operating income before depreciation), and Datastream. In total, 10,985 companies from 11 countries were selected by the criteria. However, regression was implemented for the period between 2005Q1 and 2013Q4.[iv]

4.2 Index and abnormal returns

To gain market abnormal returns, and to overcome the limitation of data, market indices were created. Even though there are several methods to calculate a market index, the market value-weighted index is used in this paper. That is,

$$Index_t = \frac{\sum_i N_t^i * P_t^i}{\sum_i N_{t-1}^i * P_{t-1}^i} * 100$$

The base market capitalization needs to be adjusted in situations where the number of shares varies, such as corporate split-off. Thus, when a change in the number of shares is observed, a new base market capitalization is calculated by an equation:

$$BC_t = BC_{t-1} * \frac{CC_{t-1} \pm \Delta CC_t}{CC_{t-1}}$$

where $BC_t$ denotes the base market capitalization at time t, and $CC_t$ is the current market capitalization at time t. Index returns were calculated on a daily basis from Jan 1 of 2003 to Dec 31 of 2013. The calculation of abnormal returns is

$$AR_t = \boldsymbol{R}_t - \boldsymbol{R}_t^*$$

where $\boldsymbol{R}_t$ is index return at time t, and $\boldsymbol{R}_t^*$ denotes normal returns estimated by the moving average process of order 4,

[iv] In most countries, there were huge changes in the available Compustat data during 2003Q1 and 2005Q1. To evade the bias caused by the dramatic change in the available data, a regression period was set between 2005Q1 and 2013Q4.

$$R_t^* = \frac{R_{t-1} + R_{t-2} + R_{t-3} + R_{t-4}}{4}$$

4.3 Standardized unexpected earnings

To reduce the bias caused by dramatic changes in the number of index constituents, an average of aggregate earnings is used.

$$Y_t^A = \frac{\sum Y_t^i}{N_t}$$

where $Y_t^i$ denotes earnings of i th company, and $N_t$ is number of companies at time t. Then, the seasonally differenced average earnings are standardized.

$$Y_t^* = \frac{Y_t^A - Y_{t-4}^A}{SD\,(Y_t^A - Y_{t-4}^A)}$$

where $Y_t^*$ is the standardized unexpected earnings, and $SD\,(Y_t^A - Y_{t-4}^A)$ denotes the standard deviation of seasonally differenced average earnings.

Average earnings are used to stabilize the time-series of earnings, although it is not consistent to the previous studies of Lee and Rui (2011), and Bernard and Thomas (1990). The aggregate earnings processes in most countries were non-stationary due to a dramatic change in firm numbers in each quarter and the global financial crisis in 2008. Also, winsorization was implemented for $Y_t^*$ by replacing values larger or smaller than the mean, plus or minus two standard deviations to eliminate the effects of outliers.

4.4 Estimation of relative weights

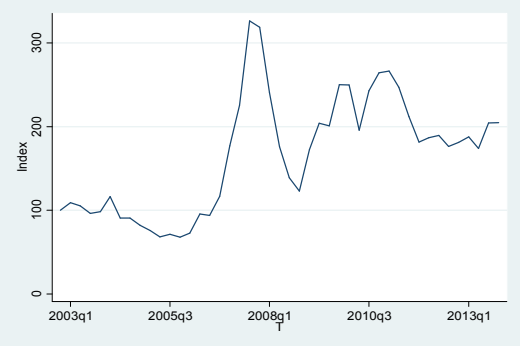
The estimation procedure for relative weights and the earnings response coefficient is similar to Lee and Rui (2011).

# Figure 1

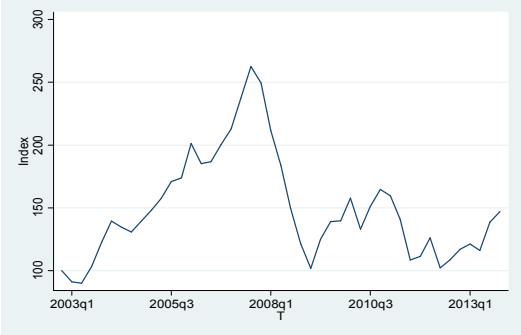
## Stock Market Graphs

The figures are indices of 10 countries. The base date of all indices is Jan 1, 2003, and base value of indices is 100.

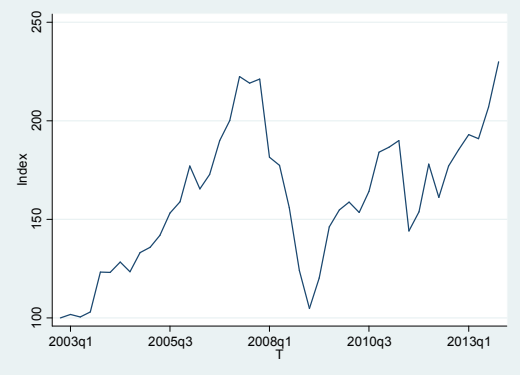

Austria




China

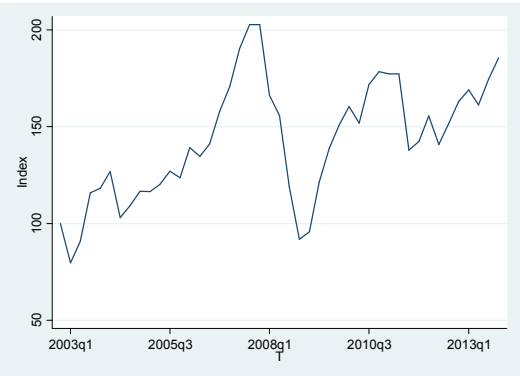



Finland

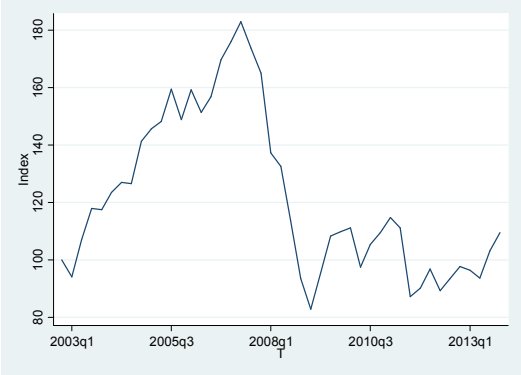



Germany

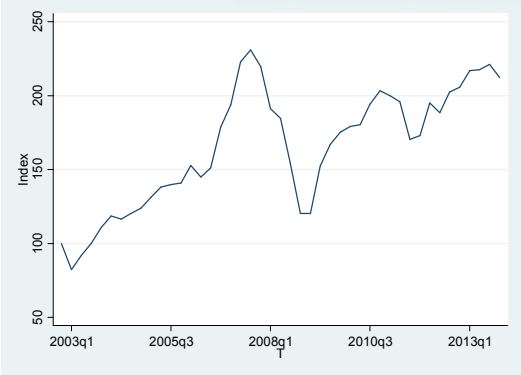

Greece



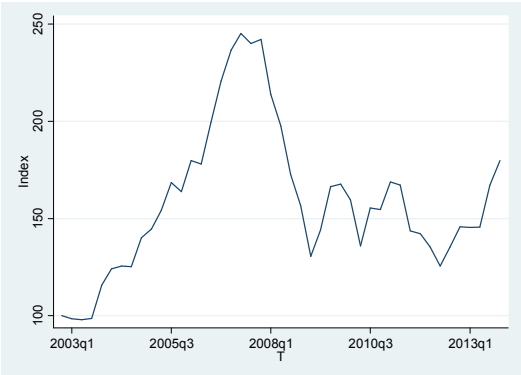

Hong Kong



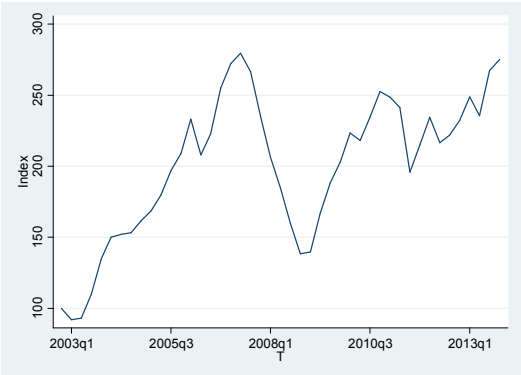

Italy



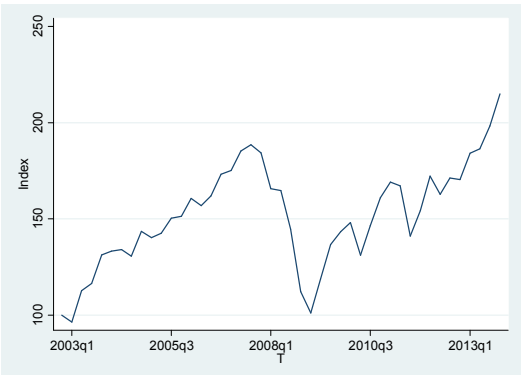

Singapore




Spain




Sweden




USA

As Lee and Rui (2011) did, the final regression equation is driven from

$$AR_t = w\lambda[Y_t - E_{t-1}(Y_t)] + (1-w)\lambda[Y_t - E_{t-1}(Y^P)]$$

$$= w\lambda e_t + (1-w)\lambda[Y_t^* - g]^{v}$$

$$= -(1-w)\lambda g + \lambda e_t + (1+w)\lambda[Y_t^* - e_t]$$

$$= b_0 + b_1 e_t + b_2[Y_t^* - \hat{e}_t]$$

$$Y_t^* = \frac{Y_t^A - Y_{t-4}^A}{SD\,(Y_t^A - Y_{t-4}^A)} = g + C(L)e_t$$

Then two stage regressions are for

$$Y_t^* = f + a_1 Y_{t-1}^* + a_2 Y_{t-2}^* + \cdots a_r Y_{t-p}^*$$

$$AR_t = b_0 + b_1\hat{e}_t + b_2[Y_t^* - \hat{e}_t], + \xi_t$$

where $\hat{e}_t = Y_t^* - (\hat{\hat{f}} + \hat{a}_1 Y_{t-1}^* + \hat{a}_2 Y_{t-2}^* + \cdots \hat{a}_p Y_{t-p}^*,)$, and $\xi_t$ is a disturbance, $b_1 = \lambda$, and $b_2 = (1-w)\lambda$.

Then, the estimators of the earnings response coefficient, $\lambda$, and market efficiency measure, $w$ are

$$\hat{\lambda} = b_1, \widehat{w} = 1 - \frac{b_2}{b_1}.$$

4.5 Determination of order p

[v] By assuming invertibility of the moving average process, and $\big(\mathrm{C(L)} - \mathrm{C(1)}\big)L^4(1-L^4)^{-1} \approx 0$, we have $Y_t - E_{t-1}(Y^P) = Y_t^* - g$.

From the assumption that $Y_t^*$ is invertible, we can consider that $Y_t^*$ can be estimated by the autoregressive model of p. The order of the autoregressive process plays an important role, because it determines $Y_t^* - e_t$, and $e_t$.

To guarantee the stationarity of $Y_t^* - e_t$, and to have interpretable results, the following criteria to determine the order of p were considered: (1) Bayesian Information Criterion (BIC) test result, (2) stationarity of $Y_t^* - e_t$, and (3) interpretability of regression results.

Firstly, the BIC test was implemented for the maximum order of 10. Secondly, the unit-root test (Dickey-Fuller test) was implemented to check whether the selected order from the BIC test made the stationary process of $Y_t^* - e_t$. Thirdly, a regression was done to test whether the order that passed the previous two tests maintained the assumption that $w$ is between 0 and 1. In all, the orders that passed the Dickey-Fuller test[vi] are the nearest to the results of BIC test, and the results in an interpretable regression result were chosen.

[vi] The selected orders passed at least a 5% significance level of the Dickey-Fuller test.

Table2

Descriptive Statistics on Variables

This table describes descriptive statistics on variables: aggregate earnings, average of aggregate earnings, index returns, estimated normal returns index, abnormal returns, standardized unexpected earnings, and residuals of standardized unexpected earnings.

Time period of aggregate earnings, average of aggregate earnings, index returns, and normal returns index is from 2004Q1 to 2013Q4, and other variables, such as abnormal returns, standardized unexpected earnings, and residuals of standardized unexpected earnings, are from 2005Q1 to 2013Q4.

| Country | $Y_t$ | | $Y_t^A$ | | $R_t$ | | $R_t^*$ | | $\widehat{AR}_t$ | | $\widehat{Y_t^*}$ | | $\hat{e}_t$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std.Dev | Mean | Std.Dev | Mean | Std.Dev | Mean | Std.Dev | Mean | Std.Dev | Mean | Std.Dev | Mean | Std.Dev |
| Austria | 2848.355 | 658.0848 | 61.6256 | 11.3120 | 0.0256 | 0.1222 | 0.0467 | 0.1087 | -0.0341 | 0.1448 | 0.1790 | 0.4775 | 0.0402 | 0.5570 |
| China | 116610.1 | 64152.44 | 72.0957 | 27.08034 | 0.0348 | 0.1906 | 0.0312 | 0.1221 | 0.0084 | 0.2536 | 0.2593 | 0.4115 | 0.0037 | 0.6350 |
| Finland | 4607.948 | 1098.401 | 43.0738 | 9.5028 | 0.1157 | 0.1186 | 0.1353 | 0.0699 | -0.0027 | 0.152 | -0.0447 | 0.2811 | -0.0260 | 0.5762 |
| Germany | 40680.72 | 6381.157 | 90.3673 | 19.7788 | 0.0207 | 0.0991 | 0.0216 | 0.0542 | 0.0011 | 0.1294 | 0.0529 | 0.4940 | 0.0363 | 0.5581 |
| Greece | 1473.423 | 443.1989 | 10.6797 | 2.9330 | 0.0024 | 0.1263 | 0.0067 | 0.084 | 0.0035 | 0.1486 | -0.1186 | 0.2078 | -0.0232 | 0.5179 |
| Hong Kong | 52667.37 | 26402.13 | 104.9446 | 41.6135 | 0.0170 | 0.109 | 0.0208 | 0.0659 | -0.0004 | 0.1466 | 0.5864 | 0.9035 | 0.0493 | 0.7084 |
| Italy | 19863.39 | 411.001 | 102.9817 | 17.2547 | 0.0021 | 0.0867 | 0.0023 | 0.0499 | -0.0038 | 0.1092 | 0.1326 | 0.4193 | 0.0325 | 0.5100 |
| Singapore | 5591.663 | 1019.262 | 18.9418 | 2.8779 | 0.0202 | 0.0888 | 0.0253 | 0.0548 | -0.0050 | 0.1255 | -0.1101 | 0.4406 | 0.0379 | 0.3619 |
| Spain | 16820.57 | 2805.53 | 191.6435 | 25.0161 | 0.0148 | 0.087 | 0.0145 | 0.0524 | -0.0017 | 0.1075 | -0.0918 | 0.5069 | 0.0280 | 0.4484 |
| Sweden | 71926.14 | 11102.12 | 231.8246 | 33.2872 | 0.0220 | 0.091 | 0.0278 | 0.0639 | -0.0085 | 0.1297 | 0.0548 | 0.4406 | 0.0038 | 0.4278 |
| USA | 629222.8 | 111618.2 | 164.8302 | 35.6204 | 0.0159 | 0.083 | 0.0176 | 0.04476 | -0.0013 | 0.1036 | 0.6692 | 0.6494 | -0.0035 | 0.6398 |

Table 3

## Unit-Root Test Result

This table provides unit-root test results on abnormal returns, residuals of standardized unexpected earnings, and standardized unexpected earnings. Because of firm number effects on aggregate earnings and abnormal returns, regression was implemented during the period between 2005Q1 and 2013Q4.

The following describes the Dickey-Fuller test static and the 5% critical values of each variable.

| | | Austria | China | Finland | Germany | Greece | Hong Kong | Italy | Singapore | Spain | Sweden | USA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\widehat{AR}_t$ | Test static | -3.866 | -3.029 | -3.559 | -3.616 | -3.684 | -3.008 | -3.621 | -2.959 | -3.568 | -2.93 | -3.612 |
| | 5% | -2.972 | -2.972 | -2.972 | -2.972 | -2.972 | -2.972 | -2.972 | -2.972 | -2.972 | -2.972 | -2.972 |
| $\hat{e}_t$ | Test static | -5.665 | -5.536 | -6.412 | -5.330 | -6.655 | -4.595 | -6.815 | -9.111 | -9.499 | -7.295 | -5.538 |
| | 5% | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 |
| $\widehat{Y_t^*}$ | Test static | -3.840 | -3.137 | -4.173 | -3.245 | -4.272 | -2.986 | -3.695 | -3.374 | -3.974 | -3.705 | -2.971 |
| | 5% | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 | -2.969 |

## 5. Results

### 5.1 Estimation results

The estimation results are summarized in table 4. The results show that the USA, Scandinavian countries, Austria, and Singapore have very efficient markets. However, the market efficiency measure (w) of Germany, Hong Kong, Italy, Spain, and Greece are below the average (0.61) of all the countries, even though Germany, Hong Kong, and Italy are classified as developed countries.

### 5.2 Investor protection and stock market efficiency

The eleven countries of this paper are categorized into the following groups by legal origin: common law countries (USA, Hong Kong, Singapore), French civil law countries (Italy, Spain), German civil law countries (Germany, Austria, Greece), Scandinavian civil law countries (Finland, Sweden), and Chinese civil law country (China).

The table shows that the result of the estimated market efficiency is consistent to La porta et al (2000), although the sample size of this study seems to be small.

La porta et al (2000) suggested indices that show a level of investor protection and efficiency of law enforcement. The “Antidirector Right Index” ranging from 6 to zero, “Efficiency of the Judicial System Index” ranging from 10 to zero, and ”Accounting Standard Index” shows how well investors are protected, how efficiently judicial systems are working, and how well established accounting standards are . A higher score means the investors’ rights are better protected. In table 5, “Average of Market Efficiency” is an average of $w$ of each country included in each legal origin. The results show that market efficiency is in positive relation to investor protection, as per the La porta et al (2000).

Common-law countries’ Antidirector Rights Index score is 4.00, the highest among the four categories, and its average market efficiency is 0.69, second to the Scandinavian countries. Even

Table 4

## Relative Weights and Earnings Response Coefficients

This table provides regression results of relative weights ($\widehat{w}$) and earnings response coefficients ($\hat{\lambda}$). The results are from the following equations:

$$Y_t^* = f + a_1 Y_{t-1}^* + a_2 Y_{t-2}^* + \cdots a_r Y_{t-p}^*,\ AR_t = b_0 + b_1 \hat{e}_t + b_2 [Y_t^* - \hat{e}_t],+ \xi_t,.$$

$$\hat{\lambda} = b_1, \widehat{w} = 1 - \frac{b_2}{b_1}.$$

| | Austria | China | Finland | Germany | Greece | Hong Kong | Italy | Singapore | Italy | Spain | Sweden | USA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\widehat{b_1}$ | 0.0243 | 0.156 | 0.0542 | 0.0666 | 0.102 | 0.0374 | 0.00534 | 0.125 | 0.00534 | 0.02 | 0.0428 | 0.0598 |
| | (0.0570) | (0.0633) | (0.0407) | (0.0306) | (0.0425) | (0.0421) | (0.0412) | (0.0549) | (0.0412) | (0.0382) | (0.0578) | (0.0289) |
| $\widehat{b_2}$ | 0.0066 | 0.0535 | 0.00919 | 0.0289 | 0.078 | 0.0258 | 0.0028 | 0.0252 | 0.0028 | 0.00828 | 0.00723 | 0.00143 |
| | (0.0580) | (0.0937) | (0.103) | (0.0342) | (0.099) | (0.0271) | (0.0395) | (0.0335) | (0.0395) | (0.0365) | (0.0651) | (0.0366) |
| $\widehat{b_0}$ | -0.0362 | -0.00605 | -0.000955 | -0.00276 | 0.0151 | -0.0174 | -0.00439 | -0.00706 | -0.00439 | -0.00155 | -0.00908 | -0.00203 |
| | (0.0276) | (0.0379) | (0.0246) | (0.022) | (0.0258) | (0.0338) | (0.0208) | (0.0217) | (0.0208) | (0.0183) | (0.0234) | (0.0319) |
| $\widehat{w}$ | 0.73 | 0.65 | 0.83 | 0.56 | 0.23 | 0.311 | 0.47 | 0.79 | 0.47 | 0.58 | 0.81 | 0.98 |
| Observations | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| R-squared | 0.009 | 0.161 | 0.042 | 0.079 | 0.134 | 0.039 | 0.001 | 0.122 | 0.001 | 0.006 | 0.018 | 0.137 |

*Roust standard errors in parentheses

Table 5

## Investor Protection and Market Efficiency

La Porta, Lopez-de-Silanes, Shleifer, and Vishny's (2000) "Antidirector Right Index" ranging from 6 to zero, "Efficiency of the Judicial System Index" ranging from 10 to zero, and " Accounting Standard Index" shows how well investors are protected, how efficiently judicial systems are working, and how well accounting standards are established. A higher score means a better system. The average of market efficiency ($w$) averages the countries included in each legal origin. Table 5 shows that market efficiency has a positive relation to investor protection as in La porta et al (2000).

| | Common Law (3 countries) | French civil law (2 countries) | German civil law (3 countries) | Scandinavian civil law (2 countries) | Chinese civil law[vii] (1 country) |
|---|---|---|---|---|---|
| Antidirector rights index | 4.00 | 2.33 | 2.33 | 3.00 | 3 |
| Efficiency of the judicial system | 8.15 | 6.56 | 8.54 | 10 | N/a |
| Accounting standards | 69.92 | 51.17 | 62.67 | 74 | N/a |
| Average of market efficiency ($w$) | 0.69 | 0.53 | 0.51 | 0.82 | 0.65 |

[vii] Although China is not included in La porta et al (2000), Franklin Allen, Jun Qian, and Meijun Qian (2005) evaluated Chinese investor protection system using La porta et al (2000) indices.

though the Antidirector Rights Index of Scandinavian countries is ranked second, the efficiency of their judicial systems and accounting standards are higher than any other legal origins. Also, the average market efficiency score of Scandinavian countries is 0.82, the highest score. The French and German legal systems show little difference in their evaluation of investor protection. As we might expect, there is also little difference in their market efficiencies. This result shows that La porta et al (2000)'s conjecture that better investor protection leads to better financial markets is right.

Although China is not one of the countries studied in La porta et al (2000), Franklin Allen, Jun Qian, and Meijun Qian (2005) evaluated investor protection and effectiveness of law enforcement in China, using indices of La porta et al (2000). China's shareholder protection falls in between the common law countries and French/German Civil law countries. Even though the shareholder protection score of China looks consistent to the market efficiency score, considering government corruption, and the poor effectiveness of law enforcement of China, it is not a reliable interpretation.

A possible explanation for the surprisingly high market efficiency of China is its high turnover velocity. According to Allen et al (2005), the domestic turnover velocity in China is 224.2%, the highest figure among the largest stock markets in 2002. Turnover velocity is a proxy of market liquidity and is about the activeness of market participants. Remembering that a market becomes efficient due to the actions of its investors, it is possible that the Chinese market is very active and this leads to good market efficiency.

## 6. Limitations of this study

This study bears several problems caused by the change in the number of available companies in each time period, firm size effect, inconsideration of dividend yield, and a limited representativeness of the index.

### 6.1 Change in number of available companies

In this study, all companies available in each time period are used. However, because of a dramatic change in the number of available companies, especially during the period between 2003Q1 and 2005Q1, and an unclear reason why there are a number of available company changes in Compustat, it is possible that the return index and the aggregate earnings contains bias. Specifically, the bias affects the stationarity of the standardized earnings process, and it interrupts gaining a good regression result.

Israel is a good example for this problem although it is not included in the final results. Figure 2 shows the dramatic change in company numbers. The change affects the process of average earnings, seasonally differenced earnings, and $Y_t^* - \hat{e}_t$, and it made difficult to include Israel in the final results.

To reduce the effectiveness of the bias, average earnings were used. Although it was successful to gain results for the eleven countries, it seems that the bias was not eliminated completely, and also made it difficult to have results for other countries.

The bias has an effect on not only the stationarity of the earnings process, but also on the return index, which can be affected by a change in company numbers caused by economic fluctuations in reality. However, in this paper, the change is also made because of availability of data. Thus, there is a possibility that the result is biased.

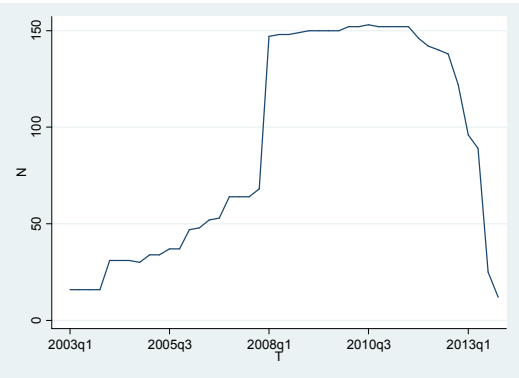
6.2 Firm size effect problem

The sudden inclusion of big companies into the earnings process also can be a problem, because it also affects the stationarity of this process. Also, since inclusions of big companies are not due to an economic reason, but due to availability of data, it casts doubts on the representativeness of selected companies. Although by using average earnings in this paper, the effectiveness of the bias is reduced, still it seems to remain.

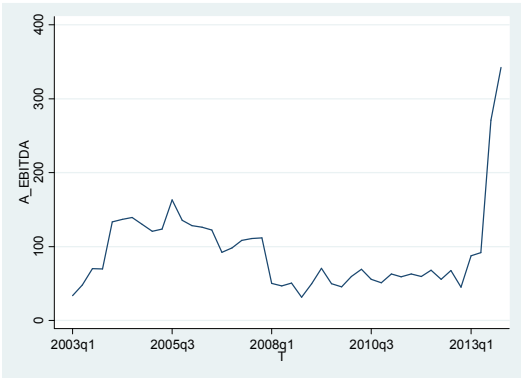
# Figure 2

## Effectiveness of Dramatic Change in Company Numbers

These figures show dramatic change of company numbers, average earnings, seasonally differenced earnings, and $Y_t^* - \hat{e}_t$. The number of available companies affects the other three variables, and the change makes the processes non-stationary.




Number of companies




Average earnings

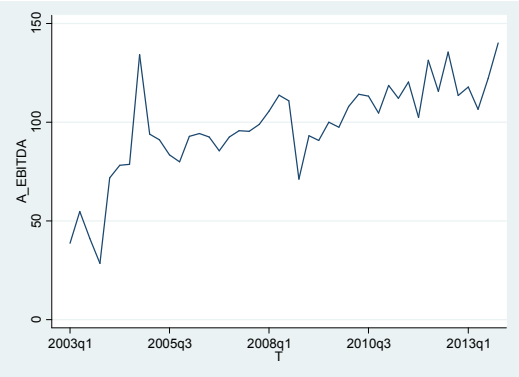

$Y_t^A - Y_{t-4}^A$


$Y_t^* - \hat{e}_t$

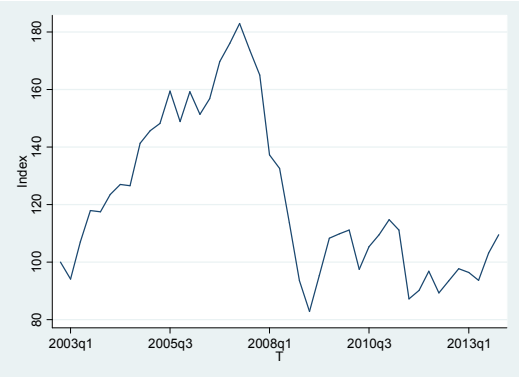
# Figure3

## Average Earnings, and Index Movement of Italy

Figure 3 shows the average earnings and index of Italy. It is natural to think that there is a strong relation between the average earnings of companies and the movement of an index. However, it is difficult to find this relation in the case of Italy. It seems that the strong growing trend in average earnings caused by the addition of big companies over time causes the decoupling. Since the inclusion of big companies is not due to an economic reason but due to availability of data, it casts doubts on the representativeness of selected companies.




Average earnings




Stock index

Figure3 shows average earnings, and the index of Italy. It is natural to think that there is a strong relation between the average earnings of companies and the movement of an index. However, the figures show that there is a growing trend in the average earnings process, and its movement is not consistent to index. The inconsistency is caused by the inclusion of companies and to availability of data, not due to economic conditions.

### 6.3 Non-consideration of dividend yield

Generally, returns include the both capital gains and dividend yields. However, because of the limited availability of data and time, in this paper, dividend yield was not considered. In other words, the returns mean only the capital gains from stock price change, in this paper. Thus, whether abnormal returns are accurately estimated or not is not certain.

### 6.4 Limited representativeness of index

The indices of this paper are structured by using data from all available companies in each time period. Since the constituents are not chosen for economic reasons, but chosen only by availability of data, indices have limited ability to represent stock markets. Thus, this problem reduces the explanatory ability of the market efficiency measure ($w$).

### 6.5 Definition of normal market returns

To define abnormal returns, we firstly need a firm definition of normal returns. This problem is critical to insist that market is not perfectly efficient because the definition is needed to prove that there exist abnormal returns in the market caused by market inefficiency. Regarding this point, Fama (1991) says that market efficiency is not testable, and we can only test whether information is properly reflected in prices in the context of a pricing model.

In this paper, normal return is defined as a moving average of the past four quarterly index returns but the definition does not stand on a firm theoretical ground. However, it is also true that there is not a firm and general definition for normal market returns.

### 6.6 Solution for the problems

A possible solution for the indicated problems is using a portfolio that consists of a fixed number of constituents over the whole period. In that case, we can evade the problem caused by dramatic changes in the number of constituents.

For representativeness problem, constituents should be adjusted in consideration of the economic situation in each period. A possible answer is using actually traded indices with a fixed number of constituents (e.g. KOSPI200, and S&P500) if all needed data is available.

Solving problem on definition for normal market returns is the most challenging one among the indicated problems. A possible solution is from Merton (1980)'s exploratory study. The three models he suggested can be used to estimate normal returns but there should be much effort to make it generally accepted.

## 7. Conclusion

Post –announcement drift is a challenge to market efficiency hypotheses. On the basis of Lee and Rui, and Bernard and Thomas's work, it was possible to develop a new market efficiency measure.

In this paper, the market efficiency of 11 countries was measured. To estimate abnormal returns, 11 indices for each country were created by using the stock data of 10,985 companies. Also, for standardized unexpected earnings, Beveridge and Nelson's time-series decomposition was used to separate the earnings process into permanent and temporary components.

By the assuming that investors expect abnormal returns with the consideration of a weighted average of permanent and temporary components of earnings, the coefficient of temporary components following a non-random walk process was used to measure the market efficiency.

The result of estimation is consistent with the study of La porta et al (2000). They maintained that the level of investor protection is positively related to the development of a financial market, and their results show that Scandinavian civil law countries and common law countries have a higher level of investor protection and judicial efficiency. Our market efficiency estimation results show that common law and Scandinavian civil law countries have more efficient markets than German and French civil law countries.

Although there are several problems in this research, this study shows a possible relation between investor protection and market efficiency. If one finds the possibility, then the next task would be further this research on the more firm ground.

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